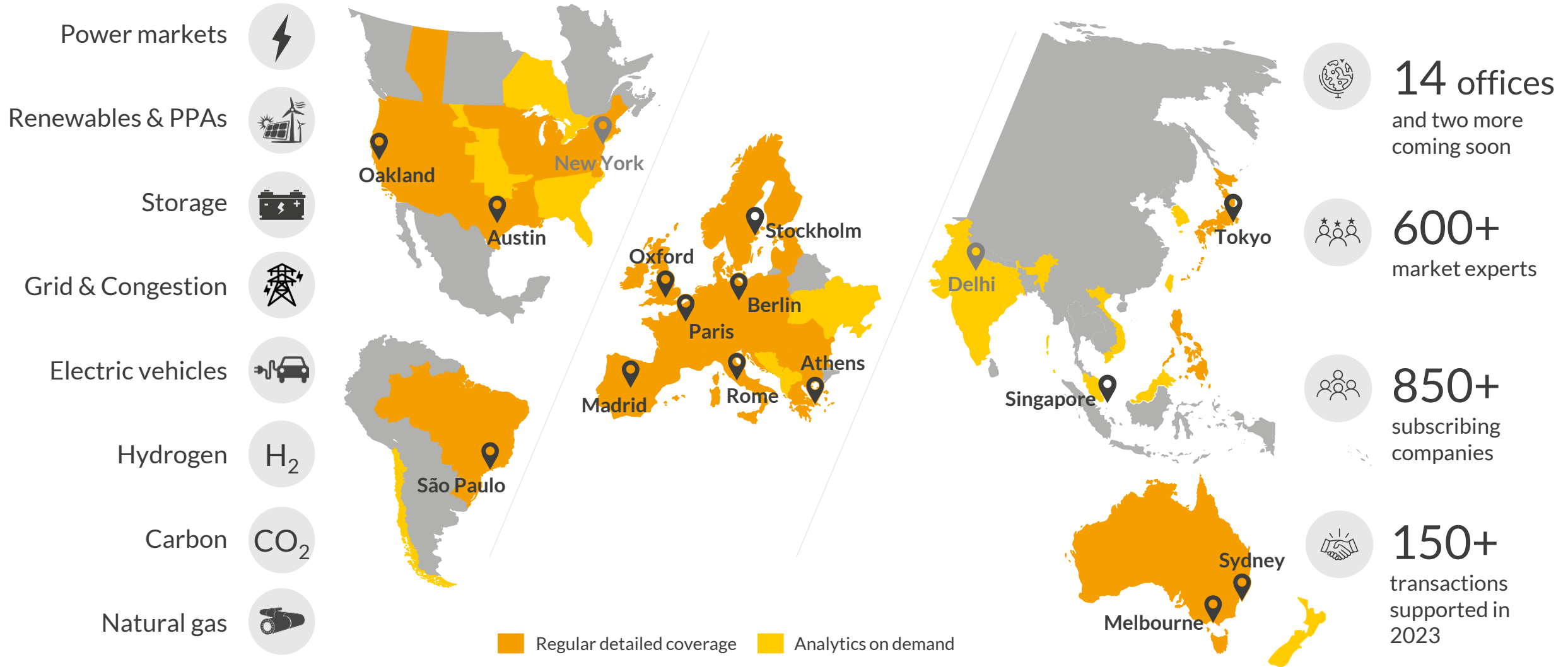


When will markets saturate? - An outlook on FCR and aFRR

Strommarkttreffen, 05.07.2024

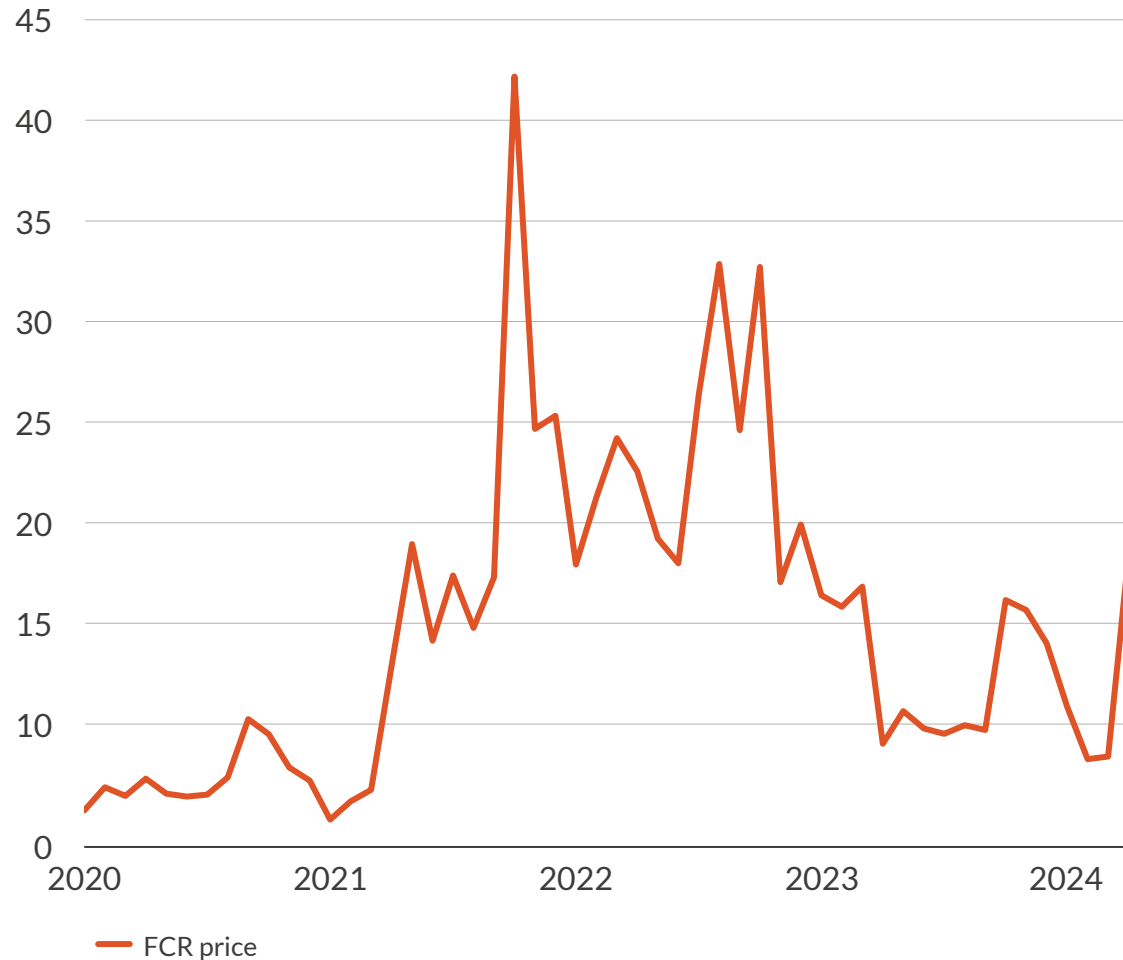


Aurora provides market leading forecasts & data-driven intelligence for the global energy transition

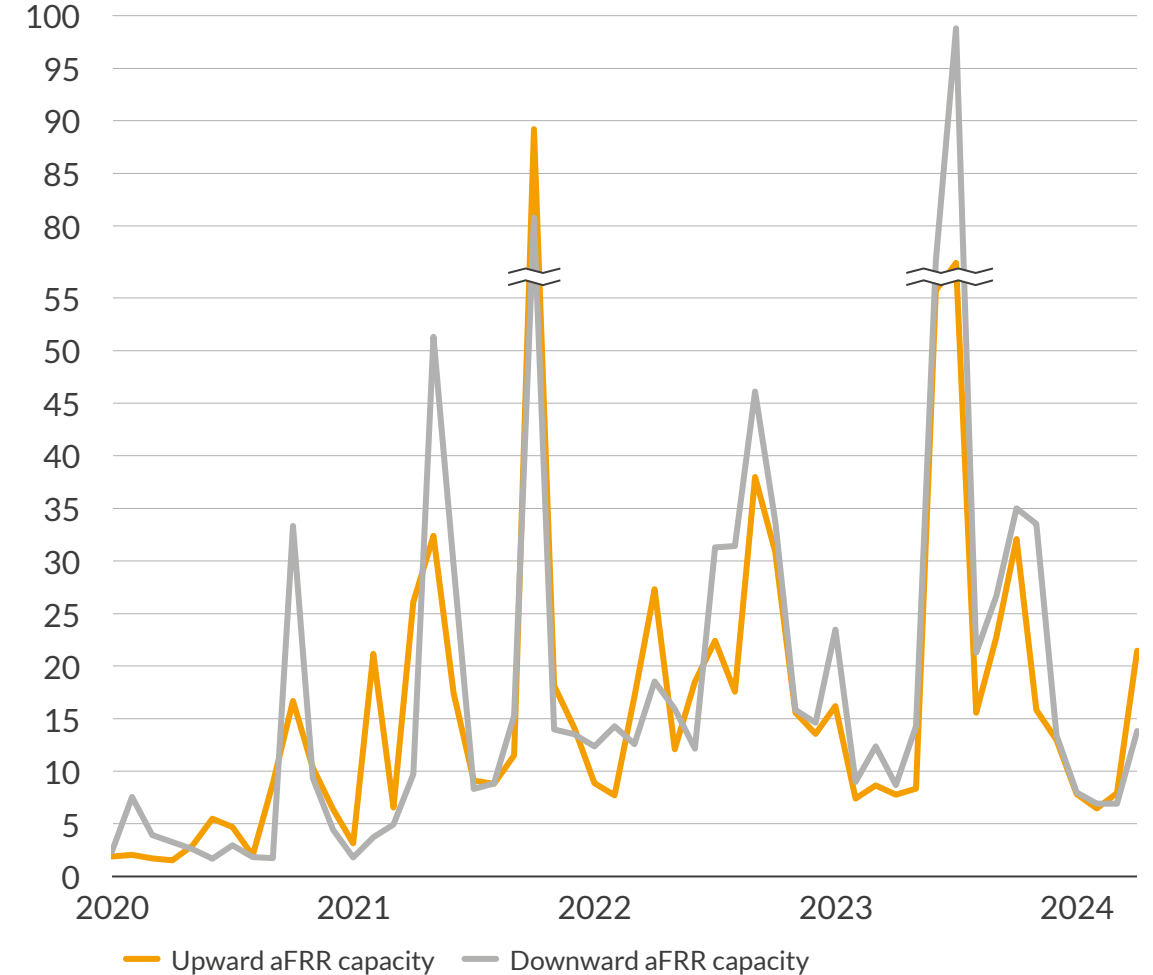


The balancing market prices were very volatile in the last years – especially on the aFRR markets we can see an increasing seasonal pattern

Historical FCR Settlement Capacity Prices in Germany¹
€/MW/h, nominal



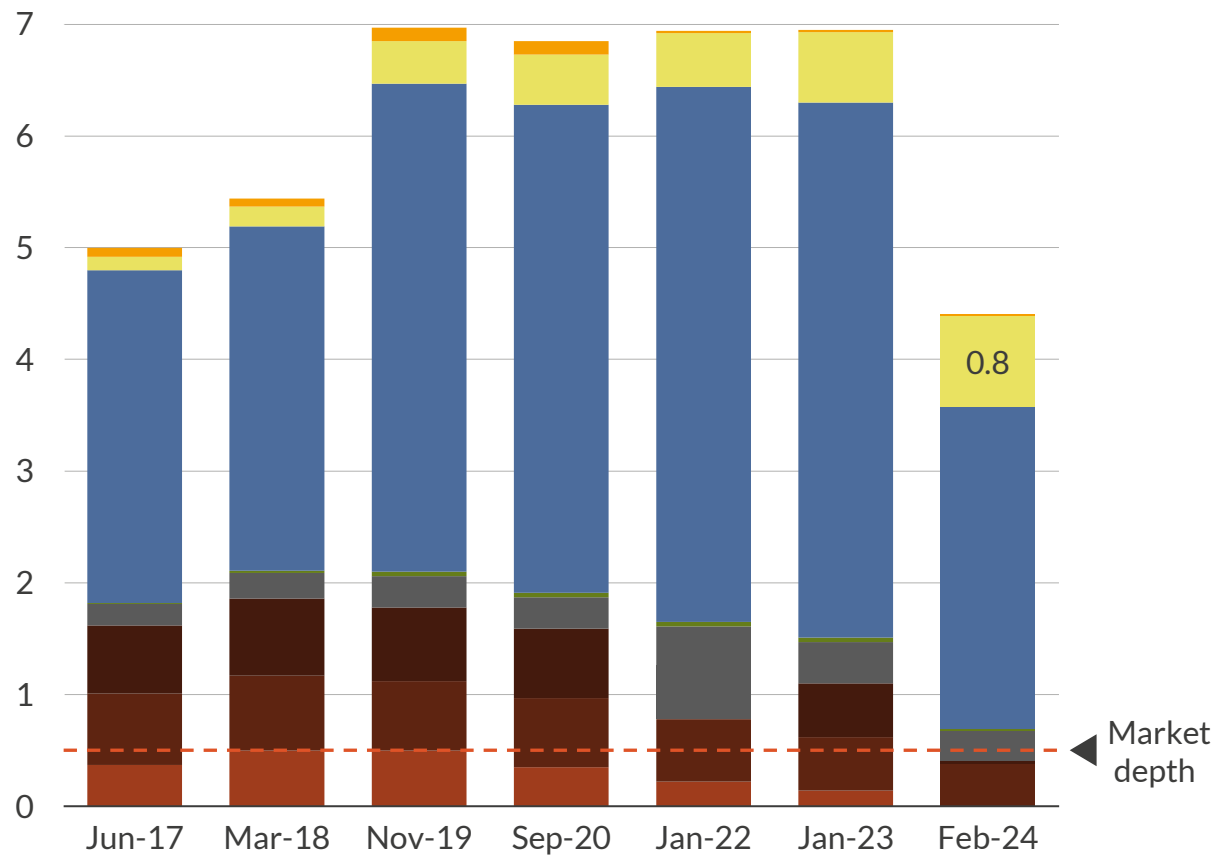
Historical aFRR capacity prices in Germany¹
€/MW/h, nominal



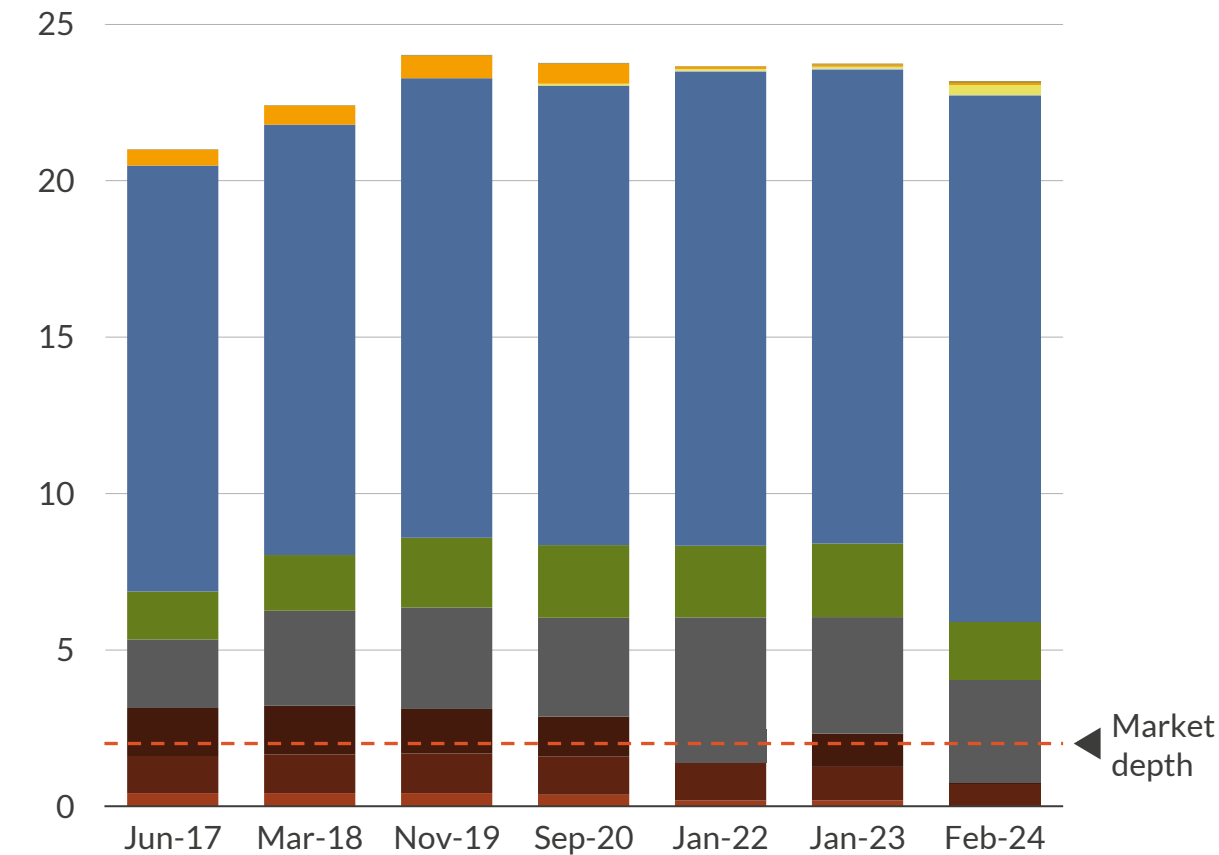
1) Includes prices until the 25th of May 2024.

Hydro is the dominating technology that is prequalified for FCR and aFRR, however, the capacity of prequalified batteries is increasing quickly

Prequalified capacity for FCR
GW



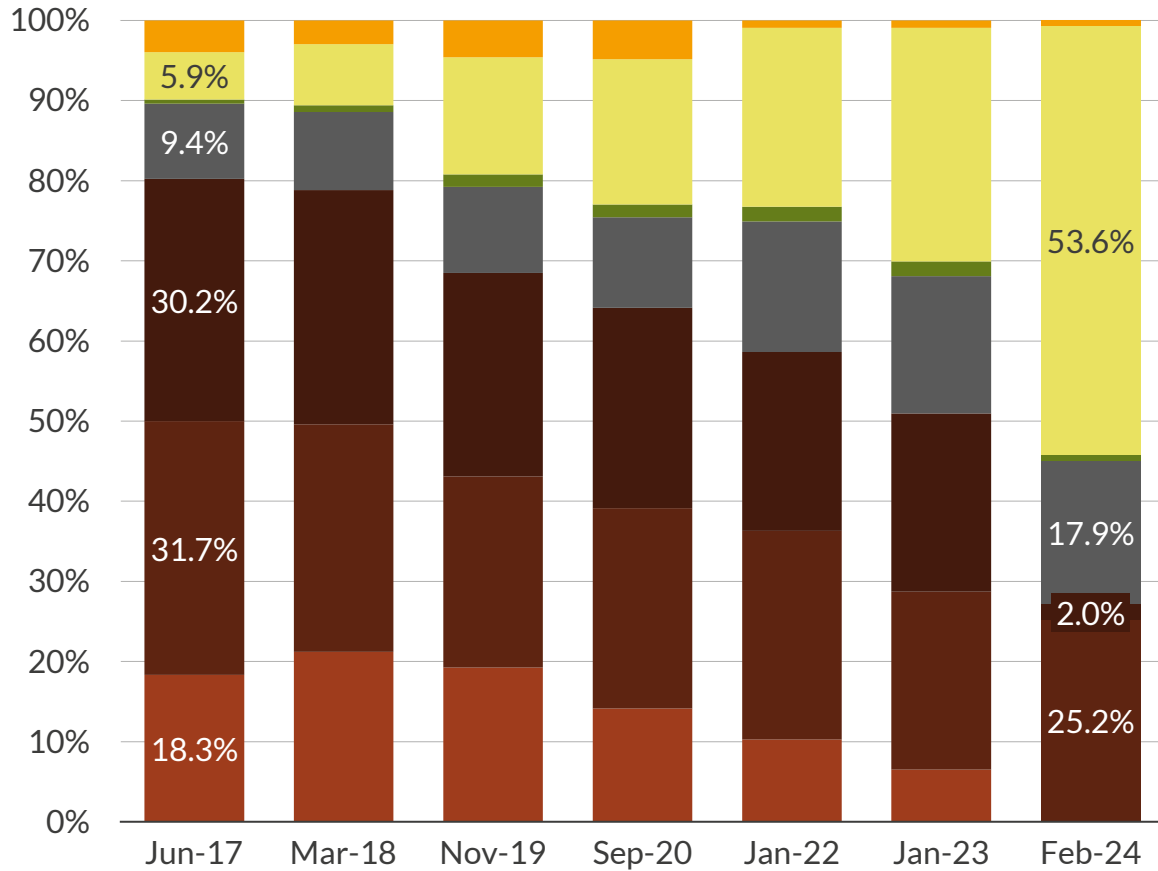
Prequalified capacity for aFRR capacity down
GW



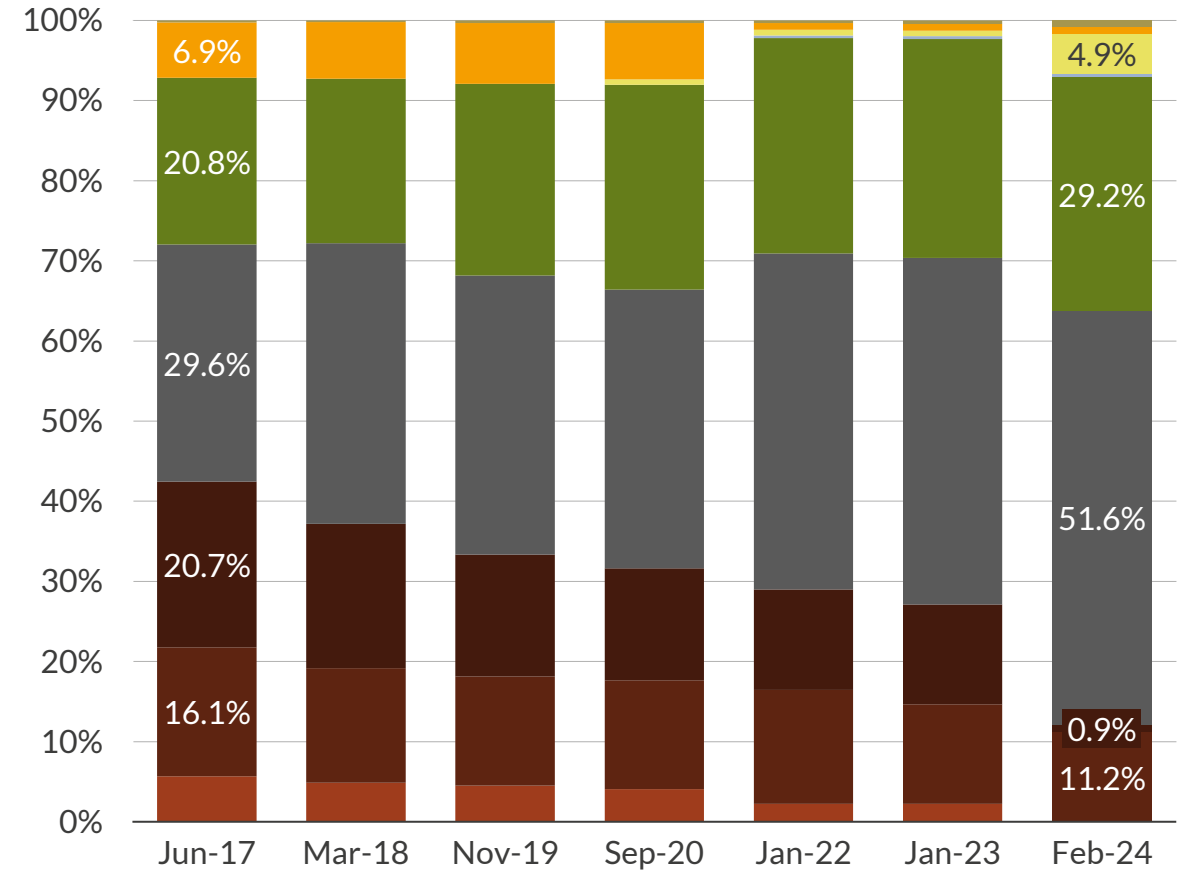
■ Nuclear
 ■ Lignite
 ■ Coal
 ■ Gas
 ■ Biomass
 ■ Hydro
 ■ Onshore wind
 ■ Battery storage
 ■ DSR
 ■ Oil peaker

While the thermal capacities that provide balancing services decrease, an increasing share of batteries enter the market - now also for aFRR

Prequalified capacity for FCR without hydro
GW



Prequalified capacity for aFRR capacity down without hydro
GW

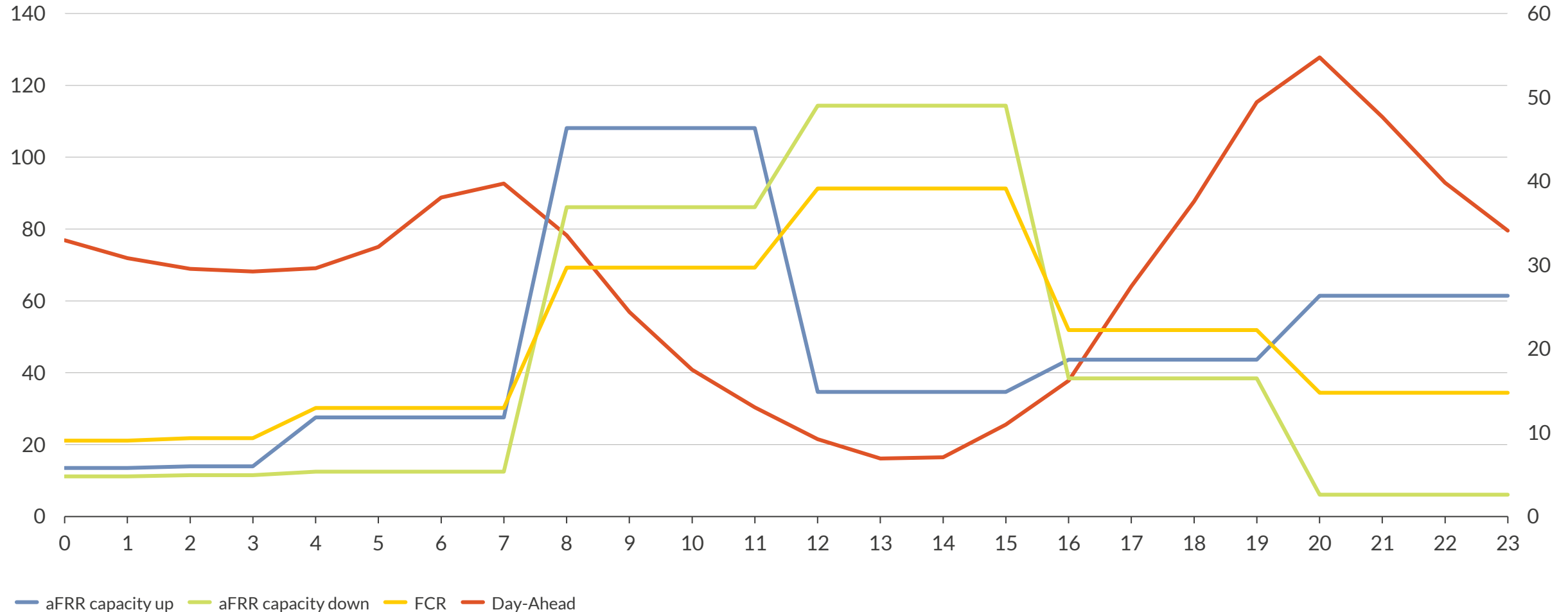


■ Nuclear
 ■ Lignite
 ■ Coal
 ■ Gas
 ■ Biomass
 ■ Onshore wind
 ■ Battery storage
 ■ DSR
 ■ Oil peaker

Few thermal plants running and high opportunity costs for storage leads to a “reverse duck curve” on the balancing markets

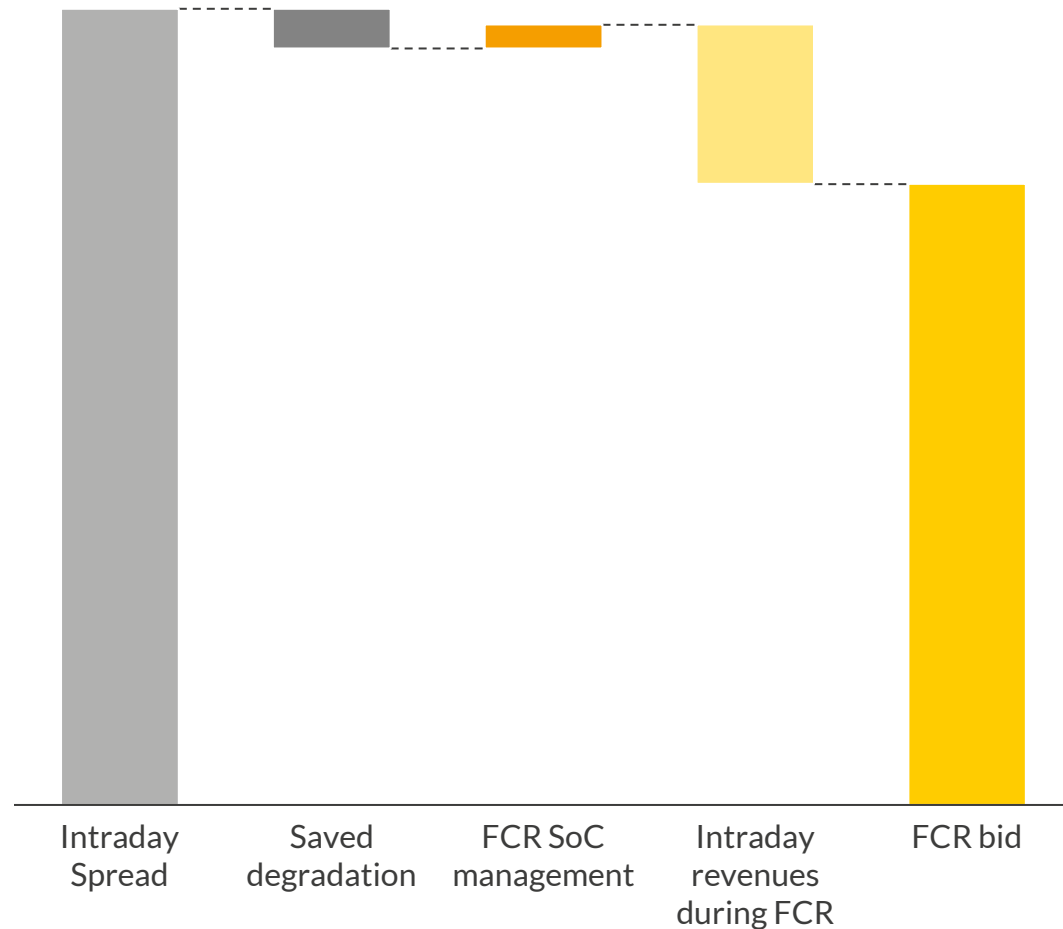
Average prices in May 2024 in Germany, Day-Ahead market
€/MWh, nominal

Average prices in May 2024 in Germany, FCR and aFRR capacity up and down
€/MW/h, nominal



With batteries dominating the FCR market, the prices will be increasingly coupled to the wholesale price volatility

Composition of the FCR bid of a battery - Illustrative Example
€/MW/h, nominal



Several factors increase the complexity of calculating the reasonable FCR bid



State-of-Charge management during the day



4h blocks do not match the optimal spread times



Quantifying the upside through Intraday trading during FCR provision



Opportunity costs on other markets, like aFRR and Day-Ahead



Different bidding behaviour of batteries with different duration or state-of-health

- 1** The **composition of the FCR and aFRR markets will change fundamentally**. The role of thermal assets will decrease and the markets will become increasingly dominated by batteries and renewable assets.
- 2** In the **short term**, less thermal generation and high opportunity costs for hydro and batteries will **increase prices during summer days**.
- 3** In the **medium term**, batteries will saturate the markets, setting the price based on their opportunity costs in other markets. This will **decrease prices** and interlink them to the volatility of the wholesale markets.
- 4** In the **medium to long term**, more and **more renewable capacity** will prequalify for FCR and aFRR capacity and with an especially strong impact on aFRR capacity down prices.

AURORA



ENERGY RESEARCH